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Original Research Article

Comparison of Physical Findings and Clinical Improvement of Nebulized Hypertonic Saline Solution

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Abstract: ***Background*:** Nebulized hypertonic saline (3% NaCl) solution may reduce these pathological changes and decrease airway obstruction and there by improve bronchiolitis. ***Objective*:** To assess the Physical Findings and Clinical Improvement of Nebulized Hypertonic Saline Solution of Hospital Stay. ***Methodology*:** Randomized, double blind controlled trial. The study was conducted in the department of pediatrics, MAG Osmani Medical College Hospital, Sylhet, Bangladesh from January 2009 to December 2009. Ninety hospitalized children (mean ± SD age, 11.1±12.3 months) with viral bronchiolitis received inhalation of (group-I), and 91 children with viral bronchiolitis received inhalation of salbutamol solution with normal saline (group-II). ***Results*:** There was improvement in both groups after inhalation of either hypertonic saline solution (Group-I) or salbutamol solution with normal saline (Group-II) on the first, second and third days after hospital admission. Head nodding and nasal flaring were reduced all the patient of both groups after second day of hospitalization and variables were not statistically significant (P> 0.05). Duration of hospitalization was 3.61±1.51 days in group-I and 3.16±1.22 days in group-II and it was not statistically significant (p>0.05). ***Conclusion*:** The study concluded that 3% hypertonic saline nebulization significantly reduced clinical severity, length of hospital stay and duration of oxygen therapy in case of acute bronchiolitis in comparison to Group I and II. Both the modalities of treatment were found to have no adverse effect. Since hypertonic saline solution is cost effective than salbutamol solution and no significant adverse events observed, it can be used in children with acute bronchiolitis.

Keywords: Physical Findings, Clinical Improvement, Nebulized Hypertonic Saline Solution.

INTRODUCTION

Bronchiolitis is the most common lower respiratory tract infection in infants. Acute bronchiolitis is the most common lower respiratory tract infection in infants throughout the world and an outbreak of bronchiolitis occurred in the winter period of 2001-2002 [1] all over Bangladesh. Infants with acute bronchiolitis have higher rates of respiratory morbidity. It often occurs in epidemics and mostly in children <24 months, with a peak incidence in infants <6 mo. Globally the annual incidence in the first year of life is about 11

cases/100 children. It is a common reason for attendance and admission to hospital. It accounted for around 3% (1.9 million) of emergency department visits in children below two years of age between 1992 and 2000 in the USA. Virtually all children become infected with RSV within 2 years after birth [2], with 1% requiring hospitalization. Recurrent wheeze or asthma is long-term sequelae after an attack of RSV bronchiolitis [3, 4]. Nearly two thirds of the cost related to annual RSV epidemics is attributable to hospitalization [2, 5]. Therefore, therapies that reduce hospital days could potentially reduce health care expenditures. Pathophysiologically, bronchiolitis is an infection of the bronchiolar epithelium, with subsequent profound submucosal and adventitial edema, increased secretion of mucus, peribronchiolar mononuclear infiltration and epithelial cell necrosis. These changes obstruct flow in the small airways, leading to hyperinflation, atelectasis and wheezing [2, 6, 7]. The goals of care for hospitalized children with acute bronchiolitis is to ensure adequate fluid intake, to provide a suitable thermal environment in which oxygen consumption will be minimized, and to administer oxygen in order to maintain adequate gas exchange [6]. Hypertonic saline solution, by absorbing water from the sub mucosa, can theoretically reverse some of the submucosal and adventitial edema and decrease the thickness and dryness of the mucosal plaque inside the bronchiolar lumen. It has been shown to increase mucociliary transit time in various situations: in vitro, in normal subjects, in patients with cystic fibrosis, and in patients with Sinonasal diseases [8, 9]. So simply hypertonic saline solution nebulizations may improve clinical sign and symptoms and there by decrease hospital stay [10-12]. Thus it may be cost effective. The commonest practice in our country is to treat hospitalized babies with acute bronchiolitis by inhalation of salbutamol solution diluted with normal saline solution, which does not reduce hospital stay[13]. We hypothesized that simply hypertonic saline solution inhalations may improve acute viral bronchiolitis by reducing submucosal and adventitial edema osmotically and allow to treat the infections with better results reducing hospitalizations, getting the patient better quicker and reducing the use of hospital resources. So if only hypertonic saline solution nebulization can improve bronchiolitis, it will be cheaper.

MATERIALS AND METHODS

It was a randomized double blind controlled trial and was conducted in the inpatient department of Paediatrics at Sylhet MAG Osmani Medical College Hospital during February 2009 to December 2009. Ninety hospitalized children (mean ± SD age, 11.1±12.3 months) with viral bronchiolitis received inhalation of (group-I), and 91 children with viral bronchiolitis received inhalation of salbutamol solution with normal saline (group-II). All the admitted bronchiolitis patients were enrolled. Systemic random sampling were done and every second case satisfying the enrolment criteria were enrolled After randomization, the code number recorded in the questionnaire; and after intervention, daily follow up and monitoring recorded on the questionnaire.

Hypertonic saline solution (x1) with hypertonic saline (x2) solution (0.05 ml/kg/dose) (total 3 ml) in nebulization group-1 was given 8 hourly. The same amounts of normal saline (x6) with salbutamol solution (x5) (0.05 ml/kg/dose) nebulization were given in the control group (group-II) in the same way. The standard treatments of acute bronchiolitis (humidified O2, correction of dehydration, fluid and nutrition, antibiotic) were given to both groups.

RESULTS

There was improvement in both groups after inhalation of either hypertonic saline solution (Group-I) or salbutamol solution with normal saline (Group-II) on the first, second and third days after hospital admission.

Table-1: Age distribution of the patients.

Age in month	Group I (n=90)		Group II (n=91)		P value
	n	%	n	%	
1- 11	68	75.6	65	71.4	
12 - 24	22	24.4	26	28.6	
Mean±SD	11.1	±12.3	9.3	±6.1	0.190^{NS}
Range (min-max)	(1.8	-74)	(1	-24)	

NS= not significant

P value reached from unpaired 't' test

The age of the patient was ranging from 1-24 months with mean age of 11.1±12.3 in group-I and age ranging from 1-24 months with mean age of 9.3±6.1 in group-II. The mean age of the patient in both group-I&II were not vary statistically significant (p>0.05).

Table-2: Distribution of patient according to Physical findings during admission.

	Group-I (n=90)		Group-II (n=91)		P value
	n	%	n	%	
Nasal Flaring	15	16.7	10	11.0	0.268 NS
Head nodding	25	27.8	21	23.1	0.467 NS
Chest indrawing	90	100	91	100	0.828 NS
Cyanosis	3	3.3	5	5.5	0.479 NS
Wheeze	90	100.0	89	97.8	0.251 NS

NS= not significant

P value reached from chi square test

Nasal flaring were 15 (16.7%) patient in group-I and 10 (11%) in group-II; head nodding were 25 (27.8) patient in group-I and 21 (23.1%) in group-II; chest indrawing were 81 (90%) in group-I and 81 (89%) in group-II; cyanosis were 3 (3.3%) in group-I and 5 (5.5%) in group-II. Wheeze were 90 (100%) in group-I and 89 (97.8%) in group-II. The difference between the two groups in relation to physical findings during admission did not vary statistically significant (p>0.05).

Table-3: Duration of hospital stay.

	Group I (n=90) Mean±SD	Group II (n=91) Mean±SD	P value
Outcome days	3.61±1.51	3.16±1.22	0.069NS
Range (min-max)	(1-7)	(1-7)	

NS= not significant

P value reached from unpaired 't' test

Mean duration (days) of hospital stay in group-I were 3.61±1.51 and in group-II were 3.16±1.22. The difference between days of hospitalization in 2 groups did not vary statistically significant (p>0.05).

Table-4: Comparison of clinical improvement after 72 hours of admission.

Follow up (Symptoms)	Group-I (n=90)		Group-II (n=91)		P value
	n	%	n	%	
Head nodding					
Day-1	25	27.8	21	23.1	
	20	22.2	16	17.6	0.516NS
Day-2	14	15.6	12	13.2	0.519 NS
	13	14.4	10	11.0	0.440 NS
Day-3	0	0.0	0	0.0	-
	0	0.0	0	0.0	-
Nasal Flaring					
Day-1	15	16.7	10	11.0	
	9	10.0	5	5.5	0.466 NS
Day-2	0	0.0	0	0.0	-
	0	0.0	0	0.0	-
Day-3	0	0.0	0	0.0	-
Chest in drawing					
Day-1	90	100.0	91	100.0	
	52	57.8	53	58.2	0.949 NS
Day-2	20	22.2	27	29.7	0.198 NS
	13	14.4	16	17.6	0.688 NS
Day-3	13	14.4	11	12.1	0.036 S
	9	10.0	4	4.4	0.107 NS

Wheeze					
Day-1	90	100.0	91	100.0	
	72	80.0	81	89.0	0.036 S
Day-2	50	55.6	64	70.3	0.175 NS
	33	36.7	39	42.9	0.578 NS
Day-3	21	23.3	23	25.3	0.685 NS
	12	13.3	15	16.5	0.582 NS

Note: 0.864, 0.174, 0.608
S= significant, NS= not significant
P value reached from chi square test

Head nodding and nasal flaring were improved in 2 groups 100% after 48 hours; but there were no statistically significant variation (p> 0.05) of clinical improvement between 2 groups. Chest in drawing improved statistically significant after 28 hours of nebulization in group-II (p<0.05) and wheeze also improved most of the patients after 72 hours but it was significantly improved in group-I patient after 12 hours (p<0.0.5).

Table-5: Distribution of clinical outcome

	Group I (n=90)		**Group II (n=91)**		**P value**
	n	%	n	%	
Improved	90	100.0	91	100.0	1.000NS
DORB	0	0.0	0	0.0	

NS=not significant
P value reached from chi square test.
All patients of group-I and group-II had improved by the treatment, which did not vary statistically significant (p>0.05)

DISCUSSION

The study included 182 bronchiolitis patient after fulfillment of inclusion criteria. Children were randomized in two groups by systemic random sampling and after randomization, in group-I was 91 and in group-II were also 91 patients. But in group-I, after first dose of inhalation one patient deteriorated and it was excluded from the study. After randomization, Group-I patient taken nebulization of hypertonic saline solution and group-II patient taken nebulization of salbutamol solution with normal saline and after nebulization, clinical variables were recoded two times daily for 3 days for each patient separately in a preformed questionnaire. Bronchiolitis commonly affects children below 2 years of age and all children become infected with RSV within 2 years after birth, with 1% requiring hospitalization [2]. Males (68.9% in group-I and 68.1% in group-II) are more affected than female. Mean age of the patients in this study were 11.1 month (±12.3 SD) and 9.3 month (±6.1SD) in group-I and II respectively. The clinical presentation of the patient in this study were cough, respiratory distress, fast breathing, chest in drawing and wheeze which were almost similar that observed by Kabir *et al*., [13]. All the patient of group-I&II were improved [14]. and this study demonstrated a significantly better improvement in clinical variables like head nodding, nasal flaring in both groups and the improvement in both groups were not statistically significant(p>0.05). Improvement of chest in drawing, and wheeze within 2days were statistically significant (p<0.05) but after 72 hours the improvement were not statistically significant (p>0.05) [15, 16]. No significant differences were demonstrated for the preinhalation clinical variables. The beneficial effect of any drug should be weighed against its side effects. The potential side effects, principally acute bronchospasm, remain a concern with nebulized hypertonic saline. This review included 90 children receiving 3% saline in repeated doses and no significant adverse events were reported. Similar observation were found by Wark and MC Donald [17] and others [18, 19] who found no reports of bronchospasm in 143 reviewed patients with relatively severe cystic fibrosis treated with hypertonic saline solution inhalations. Only one patient in group-I was deteriorated after 1st time inhalation of hypertonic saline solution and it was excluded from the study and referred to PICU for proper management. Our patient population included only hospitalized children <24 months old (mean age 11.1± 12.3 in group-I, 9.3± 6.1 in group-II). The histological evidence of recovery reveals that complete restoration of ciliated epithelial cells requires 4-8 weeks in correlation with the common clinical findings of prolonged cough, wheezing, and altered pulmonary function [20]. On the one hand, ultrasonic nebulizers induce sputum more efficiently than compressor nebulizers. On the other hand, compressor nebulizers generate aerosols with smaller aerodynamic mass median diameter which may more easily reach smaller bronchi and bronchioles [14]. Further studies are required to compare the efficacy of nebulized hypertonic saline delivered by different nebulizers in infants with viral bronchiolitis. The delivery interval of nebulization in this study was 8 hours. The delivery interval of nebulized hypertonic saline was eight hours in

different trials [21, 22] but more frequent deliveries were administrated in one trial [23]. No significant difference was observed between the studies, regarding effect sizes of treatment with 3% saline inhalation delivered at different intervals, on the reduction of length of hospital stay. However, the optimal delivery intervals of nebulized hypertonic saline in infants with viral bronchiolitis still need to be established by further studies.

CONCLUSION

The study concluded that 3% hypertonic saline nebulization significantly reduced clinical severity, length of hospital stay and duration of oxygen therapy in case of acute bronchiolitis in comparison and Physical finding follow up. Both the modalities of treatment were found to have no adverse effect. Nebulized hypertonic saline solution had improved the symptoms and sign and reduced the duration of hospital stay. Since hypertonic saline solution is cost effective than salbutamol solution and no significant adverse events observed, it can be used in children with acute bronchiolitis.

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